

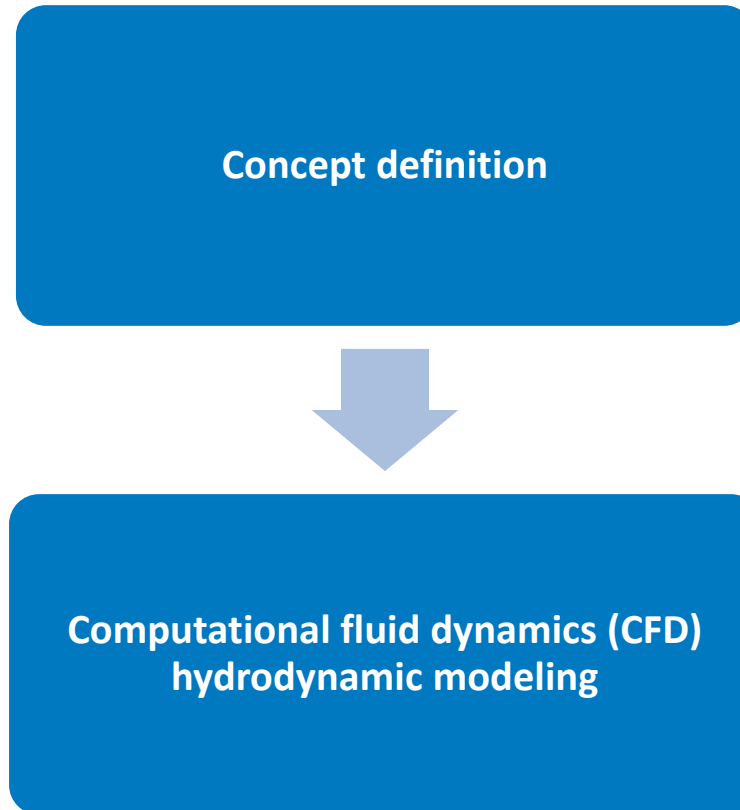
MEDA Model 5 – Bottom-hinged pitching wave energy system design and analysis



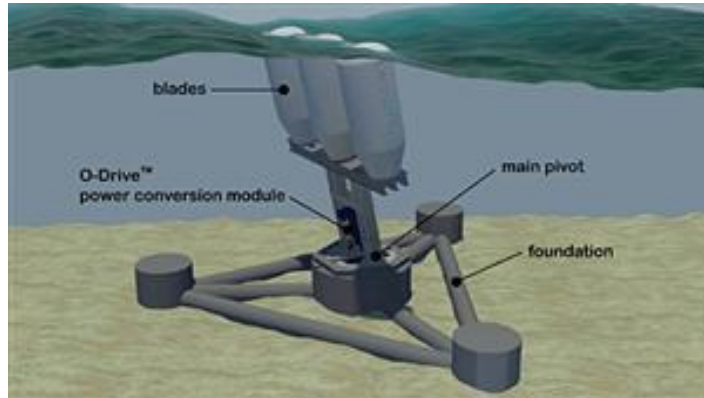
Ye Li – NREL
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MEDA Model Meeting
State College, PA
August 23-24, 2011

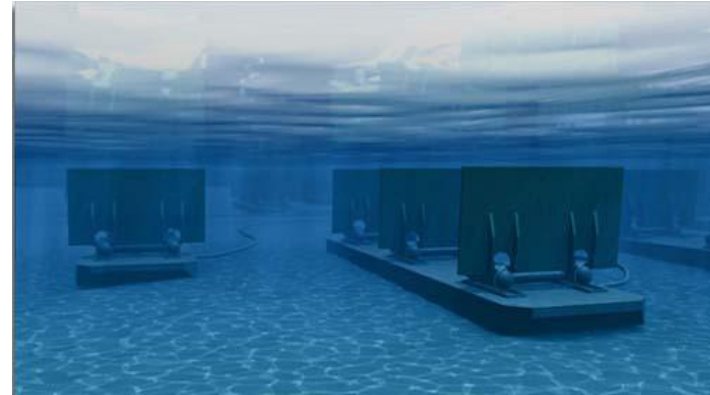
Presentation outline



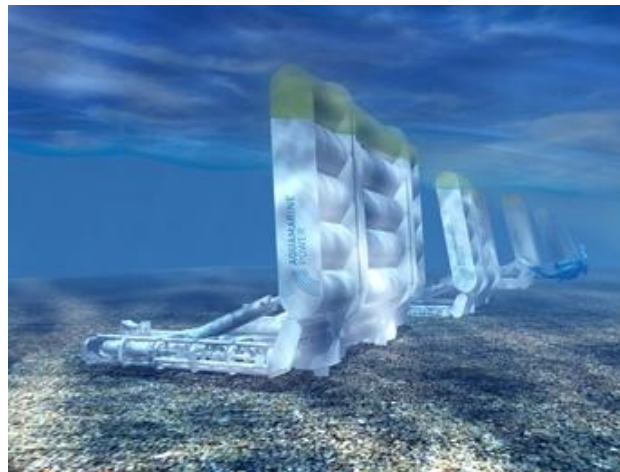
Background: several developed device concepts



BioWave



WaveRoller



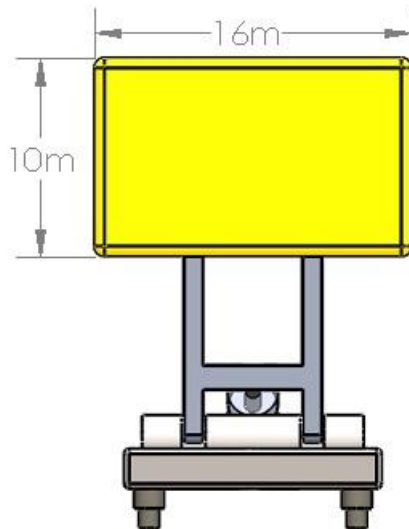
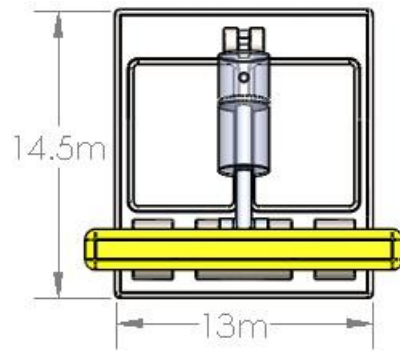
Oyster

Several design variables need to be considered

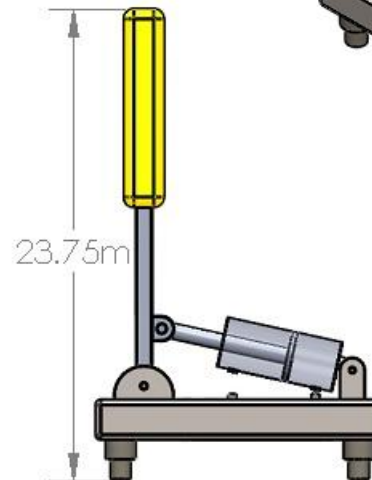
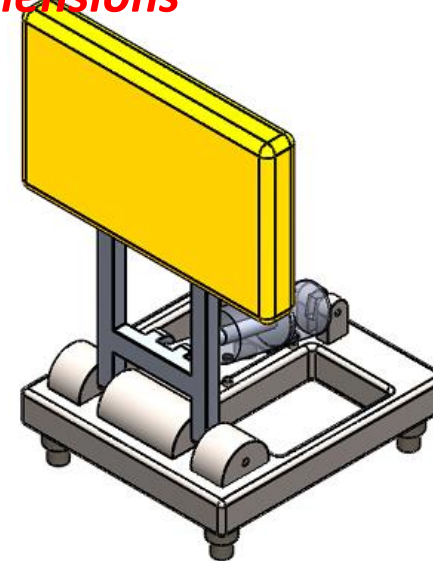
Dimensions and Shape	Flap height (including the part is above the mean water surface)
	Flap thickness (buoyancy induced pitching stiffness)
	Flap width (3D effect)
	Flap edge shape (3D effect)
Design water depth	
Structural integrity	

Device design

The device design was obtained from Sandia National Lab



****Overview of Large Dimensions***

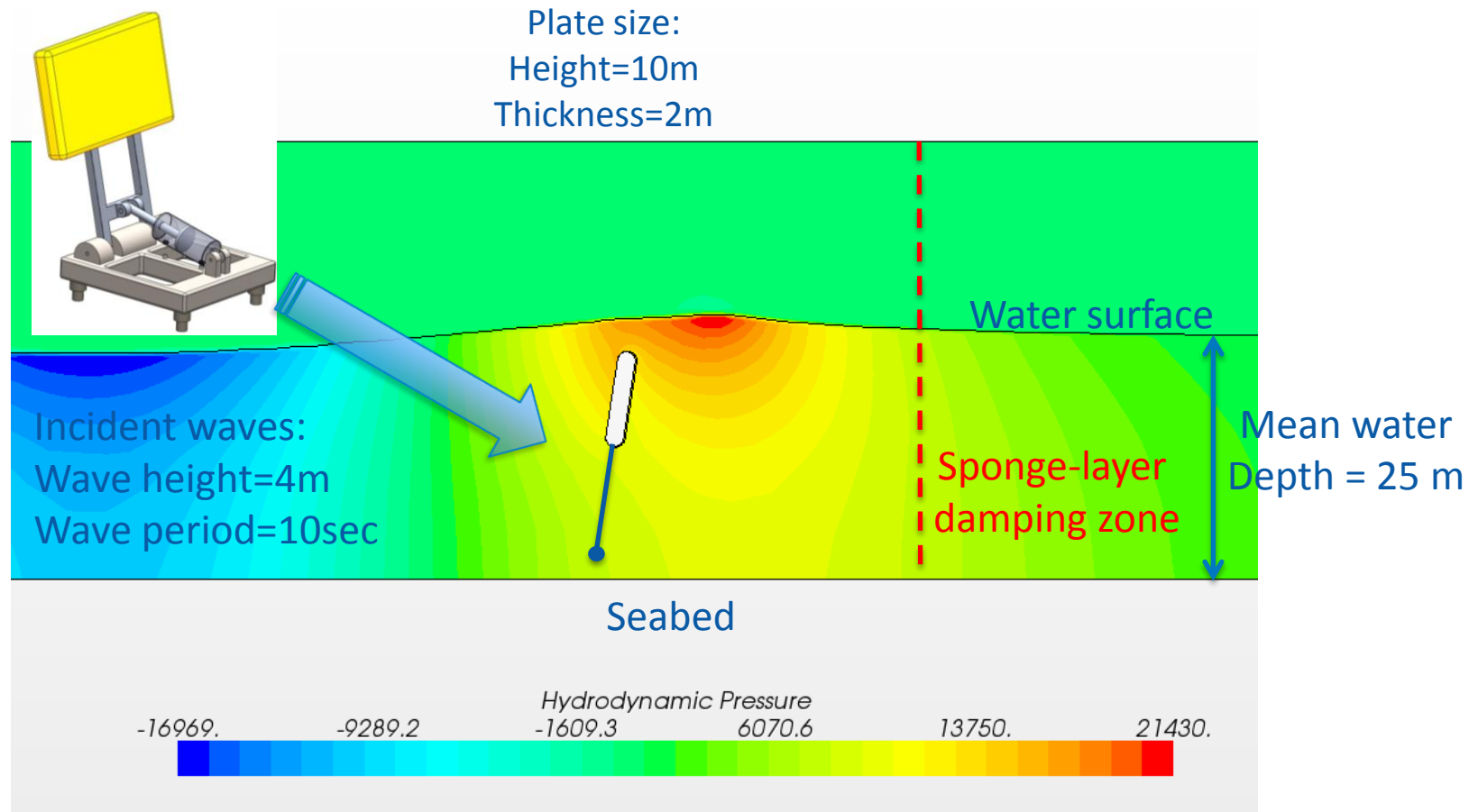


- Device is attached to the seabed and designed to operate in water depths of 20-25m.

Modeling Plan

- Potential code modeling (WAMIT or other BEM code) for basic geometry and thickness designs
- CFD simulations (FVM or SPH) for more detail analysis.
- Validation with experimental test
- Optimization based on hydrodynamic analysis results

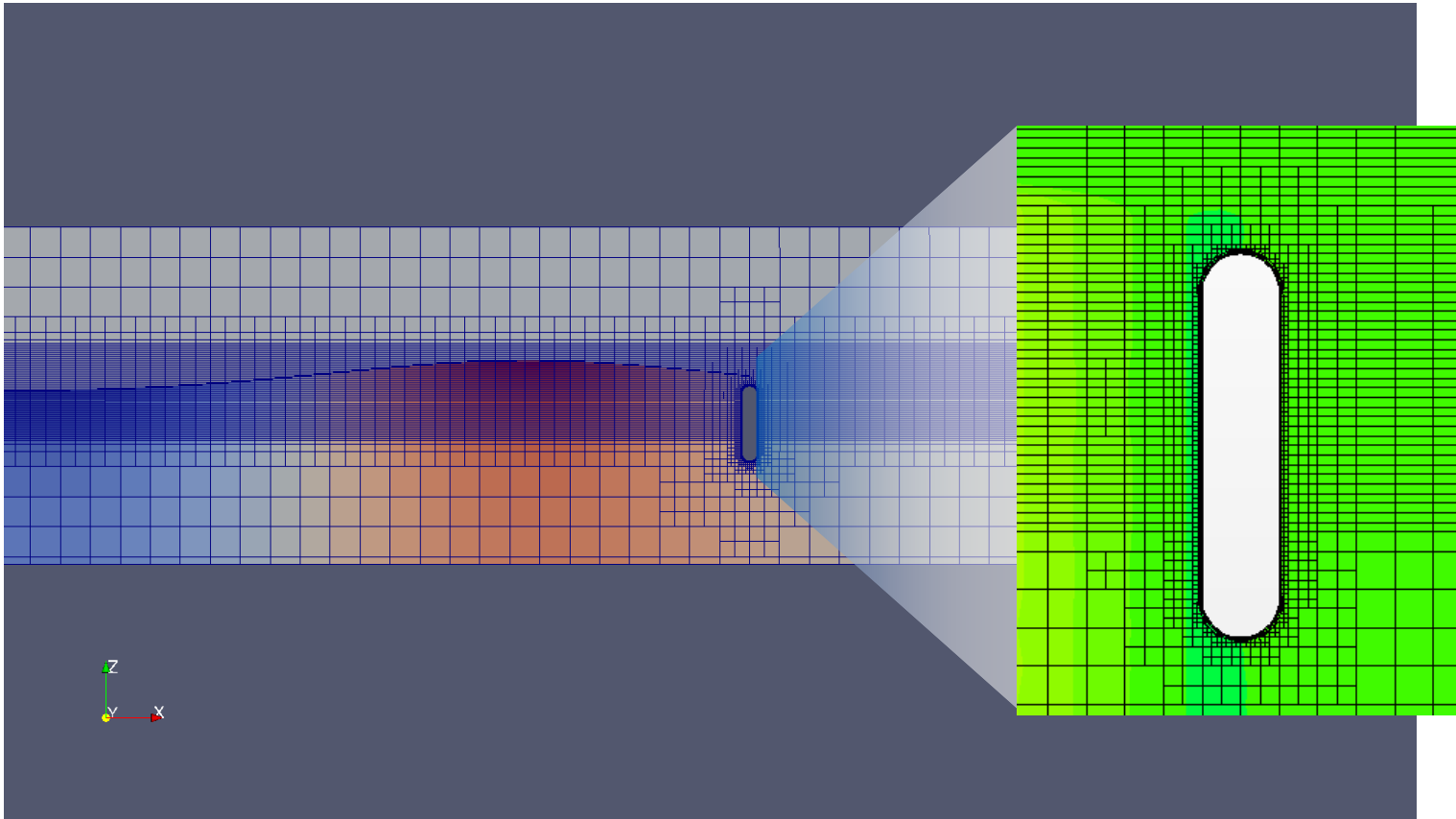
Numerical Settings for CFD Simulation



Supporting arm currently was not included in the CFD simulation

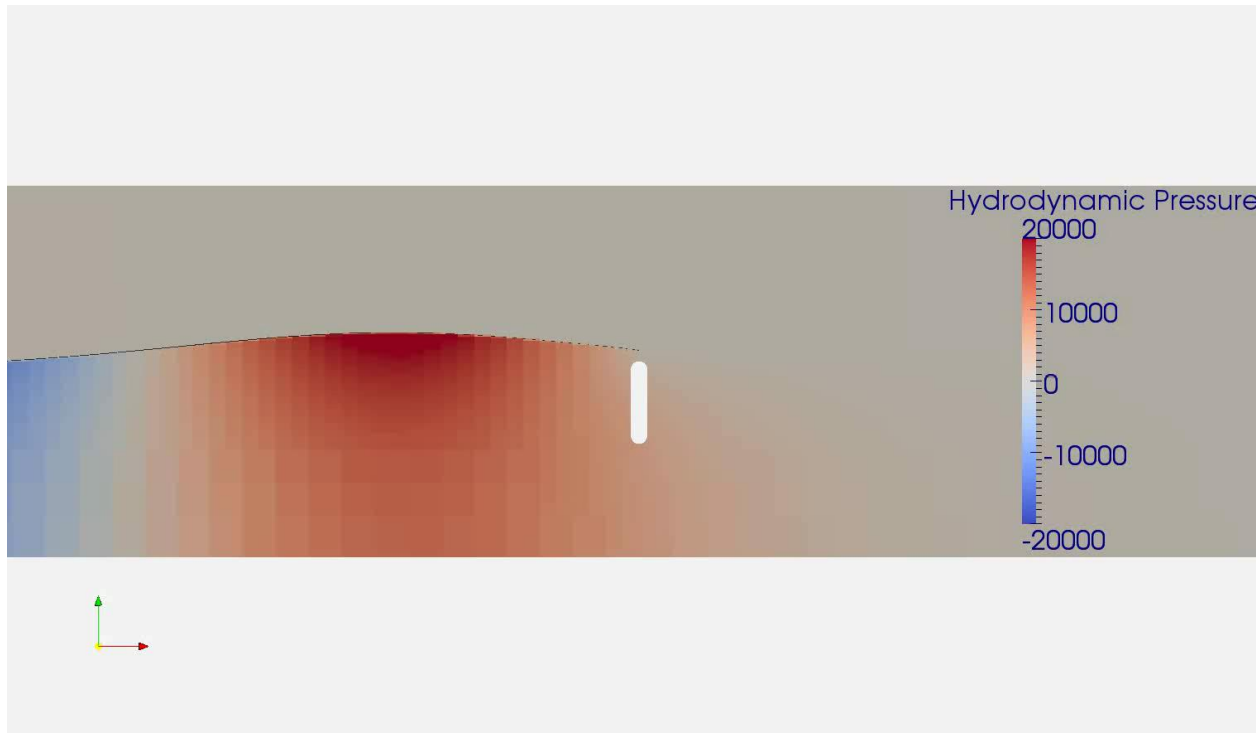
Computational Grid

Preliminary computational grid is very coarse ($N \approx 45,000$), and a grid refinement study is planned.



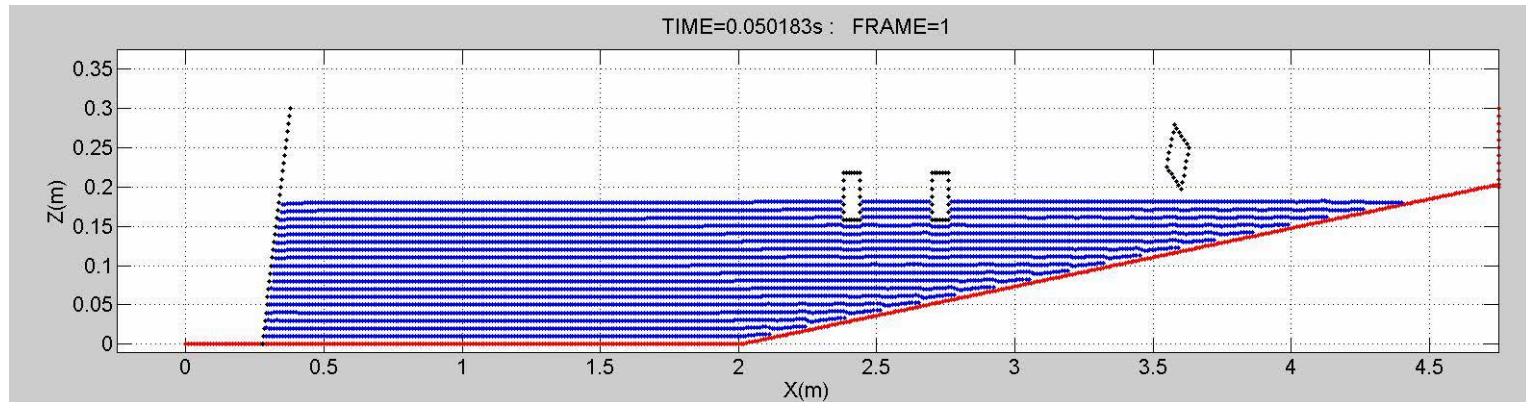
Preliminary Result

- Wave condition: $H=4\text{m}$; $T=10\text{ sec}$
- The top of the flap is 1.25m below the mean water surface.



Maximum normal force	Maximum pitch angle
15 kN/per unit width	10 degrees

Smooth Particle Hydrodynamics



Discussions

- In the current preliminary design, wave energy may be lost due to the gap between the water surface and the flap.
- To accurately predict and investigate the performance of this type of wave energy device(with extreme wave breaking and overtopping), CFD simulation is needed.
- Experimental test must be conducted in parallel with the numerical method development to ensure the quality of the design